



INVESTIGATOR'S ANNUAL REPORT

United States Department of the Interior
National Park Service

All or some of the information you provide may become available to the public.

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Reporting Year: 2008	Park: Shenandoah NP	Select the type of permit this report addresses: Scientific Study	
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Project Title (maximum 300 characters): Topographical and Hydrological Influences on the Spatial Distribution of Mercury at the Catchment Scale			
Park-assigned Study or Activity #: SHEN-00356	Park-assigned Permit #: SHEN-2008-SCI-0017	Permit Start Date: Oct 29, 2008	Permit Expiration Date: Aug 31, 2009
Scientific Study Starting Date: Oct 29, 2008		Estimated Scientific Study Ending Date: Aug 31, 2009	
For either a Scientific Study or a Science Education Activity, the status is: Continuing		For a Scientific Study that is completed, please check each of the following that applies: <input type="checkbox"/> A final report has been provided to the park or will be provided to the park within the next two years <input type="checkbox"/> Copies of field notes, data files, photos, or other study records, as agreed, have been provided to the park <input type="checkbox"/> All collected and retained specimens have been cataloged into the NPS catalog system and NPS has processed loan agreements as needed	
Activity Type: Research			
Subject/Discipline: Air Pollution Effects			

Purpose of Scientific Study or Science Education Activity during the reporting year (maximum 4000 characters):

The accumulation of mercury (Hg) in the environment from atmospheric deposition is a worldwide problem that has gained attention relatively recently [Krabbenhoft, 2004]. The form of mercury that is particularly toxic is methylmercury (MeHg), which is formed by the bacterial transformation of ionic mercury (Hg²⁺) and efficiently bioaccumulates in the food chain. It is estimated that approximately 630,000 children born each year in the U.S. alone are exposed to elevated methylmercury levels in the womb, putting them at risk of impaired neurological development [Mahaffey, 2004]. Only now are we beginning to fully grasp the widespread impact that this problem is having on human health, affecting localities hundreds of miles away from emission sources [Driscoll et al.,

2007]. Mercury concentrations in the atmosphere have increased 2-5 times those of pre-industrial levels [EPA, 1997] leading to increased deposition. Although the impact of the mercury problem is wide-ranging, the specific processes that control mercury cycling in the environment remain poorly understood.

Statistical relationships between watershed physical descriptors and mercury concentrations are relatively weak, but several key controls are worth noting. First, the degree of watershed forestation is positively related to Hg concentration since trees scavenge Hg vapor through stomatal uptake [Ericksen et al., 2003] and because organic matter is typically abundant in forested systems. Second, watersheds with wetlands tend to have high concentrations of MeHg, since reducing conditions are more favorable in these areas [Grigal, 2002]. Overall, controls on mercury concentrations are quite complex, and high spatial variability can be found within limited geographical areas. For example, Johnson et al. [2007] reported that throughfall Hg deposition varied as a function of aspect in Acadia National Park in Maine. Here, higher deposition was observed in a SW-facing catchment compared to that within a SE-facing catchment.

Studies have yet to confirm the role of aspect on distribution of Hg in litterfall and soils. Although it may be inferred that such accumulation will follow similar patterns as throughfall deposition, this relationship is not necessarily direct. Similar to Acadia, west-facing slopes in Shenandoah National Park would be expected to have greater Hg deposition due to prevailing westerly winds and the geographical distribution of coal-fired power plants. This influence of catchment aspect, however, might not persist in the organic soil Hg concentrations since local hydrological conditions influence Hg mobilization. Likewise, leaf litter concentrations might show little variability since a major pathway for Hg accumulation in leaves is through to be stomatal uptake, and the gaseous elemental form of mercury would be fairly well-mixed in the atmosphere.

We seek to develop a processed-based understanding of how mercury is deposited and transformed in natural environments by examining the spatial distribution of mercury abundance in leaf litter and soils. We plan to use a paired catchment approach to isolate the roles of aspect and mean soil wetness on these distributions. The ultimate goal is to scale up this information to predict other areas within SNP that are vulnerable to mercury accumulation.

Findings and status of Scientific Study or accomplishments of Science Education Activity during the reporting year (maximum 4000 characters):

Leaf litter collector basins were set out on the weekends of 10/27/08 and 11/2/08 at 30 sites within the North Fork Dry Run and Hannah Run (approx. 6 miles south of the Thornton Gap entrance). After, 3-4 weeks, leaf samples from within the basins and soil samples in their vicinity were collected. About 10 grams of soil was collected within the top 2 inches of soil at each of the sites. Approximately 3 soil samples/site or a total of 85 soil samples were taken (including duplicates at certain sites) for analysis. Leaves trapped within the mesh of the leaf litter collector basins were collected and stored for transport. A total of 95 leaf samples were collected from these same sites (including duplicates at certain sites)

For Scientific Studies (not Science Education Activities), were any specimens collected and removed from the park but not destroyed during analysis?

Yes

If "Yes", identify where the specimens currently are stored:

Leaf and soil samples are currently stored in freezers in Clark Hall, on the campus of the University of Virginia.

Funding specifically used in this park this reporting year that was provided by NPS (enter dollar amount):

\$0

Funding specifically used in this park this reporting year that was provided by all other sources (enter dollar amount):

\$2000

List any other U.S. Government Agencies supporting this study or activity and the funding each provided this reporting year:

Paperwork Reduction Act Statement: A federal agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a valid OMB control number. Public reporting for this collection of information is estimated to average 1.625 hours per response, including the time for reviewing instructions, gathering and maintaining data, and completing and reviewing the forms. Direct comments regarding this burden estimate or any aspect of this form to Dr. John G. Dennis, Natural Resources (3127 MIB), National Park Service, 1849 C Street, N.W., Washington, DC 20240.